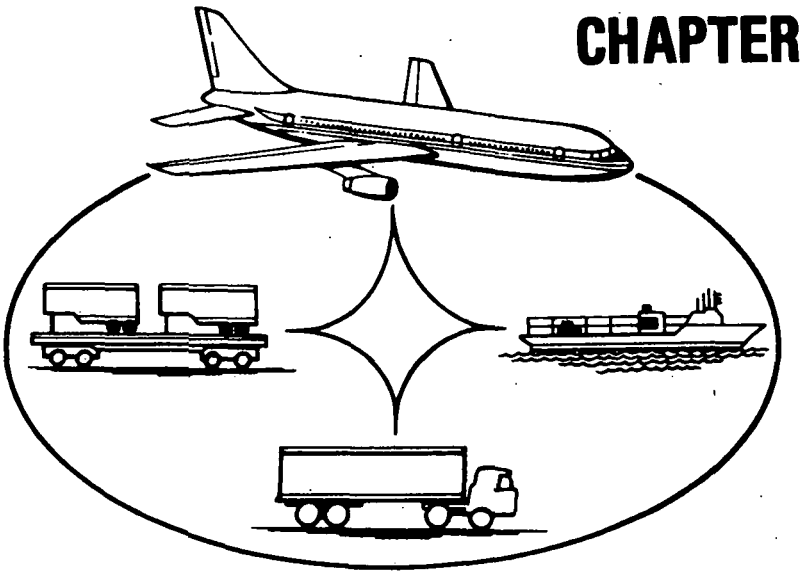
CHAPTER 2



GROUND SUPPORT

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CHAPTER 2

GROUND SUPPORT

Introduction

While traffic on the system flows through the network, it must enter that network through a ground support system. This support system includes the standard business practices used to attract cargo to the air mode, the legal and regulatory framework by which freight is interfaced between surface and air, and the terminal facilities which expedite transfer. The purpose of this chapter is to review these elements of the ground support system and prescribe how they should appear in the 1990-2015 system. It will proceed from the general design requirements of a cargo terminal, through the institutional and legal practices needed to support 1990 operations, to an analysis of the impacts of such a system. Some operating premises beyond our basic assumptions were used in this section. First, it was accepted that a number of companies would be carrying air freight at airports of any size. Hence, terminals are usually built for or by individual airlines, not to handle the total cargo volume of an airport. Second, the assumption of "no new airports" was taken literally. While new terminal facilities might be built at existing locations, the contingency of a major hub grade dedicated cargo airport was not considered. The attendant surface access problems were subsequently not addressed in a design context. Arguments against a dedicated freightport, however, were advanced. Third, the committee did not feel it was possible to offer a specific terminal design, because site idiosyncracies would preclude any acceptable general configuration. What was reported are the general elements and size of an advanced terminal facility.

2.1 CONTAINERIZATION

"In my opinion, the relationship or need for intermodality on an interchangeable containers basis between surface carriage and air freight transportation is virtually non-existent today."(ref. 1)

"Achievement of a viable large-volume air cargo service is dependent upon the use of a large unit load device . . . , and complete compatibility with the surface freight system . . ."(ref. 2)

2.1.1. Introduction

Perhaps the best way to start a discussion about containerization is to define it. This is done by the Containerization Institute in the following manner:

> "Containerization is the utilizing, grouping, or consolidating of multiple units into a large container for more efficient movement."

In the present day cargo transportation industry one can find extensive use of containers. Containers of all sizes and shapes are transported by trucks, trains, ships, and airplanes. Since everyone is using containers, one might ask why all the interest in the subject of containerization? That question is best answered by Eric Rath's statement:

> "Containerization is a systems approach to transport service. It represents the dawn of an era, in which all modes of transportation will be subjected to integration into a single, world wide system."(ref. 3)

The key word in this statement is integration. This should be taken to mean that a container is a container, is a container, etc. irrespective of the transportation mode used to move it.

An effort has been underway since the end of World War II to develop standardization in containers. This effort has met with some degree of success with the surface modes of transportation (highway, rail, sea). However, the air freight industry has not participated in this standardization. Thus, an air freight container is generally considered to be uni-modal, even though these containers are transported by truck between the customer and the airport.

Is the fact that its containers are uni-modal detrimental to the air freight industry?

If we return to the quotes given at the beginning of this section, we may well find the answer to this question. McNulty indicates that there is no need <u>at present</u> for air freight to have an intermodal container. His reason is that, since most of the air freight business is small packages in less than truck load quantities and since the standardized containers are large in size (2.44m x 2.44m x 6.1m or 12.19m), there is not sufficient demand to justify

going to a standardized container. If we look at the quote from Lockheed, we see that they suggest that sufficient demand is dependent upon intermodal air containers. We are thus left with "the chicken and the egg" problem: What comes first, the demand or the containers?

In the remainder of this section, we will examine some aspects of containerization with primary emphasis on its use in the air freight industry.

2.1.2. History

The idea of containerizing cargo is not new. It probably dates back to the days of the Roman Empire when containers (cages) were used to transport animals. However, the modern day concept of containerization got started after World War II. The first step was the use of pallets for unitizing cargo. Of course, pallets are still used extensively today. Next came the TOFC (Trailer on Flat Car) or piggyback concept developed by the railroads and the Trailers on Ships or RO-RO (Roll on - Roll off) developed by the shipping industry. Both of these concepts were initiated in the early 1950's. Note that in both cases the conventional wheeled truck trailer was used.

The next logical step was to take the wheels off the trailer thus yielding a container. By the mid-fifties, containers were being moved on container barges. Soon to follow was the containership and COFC (Container on Flat Car). With trucks and trains to move the containers over land and barges and containerships to move them over water, the freight forwarder quickly generated and sold the door-to-door service idea. In doing so, the freight forwarding industry was instrumental in the setting of standards for containers.

During the 1960's, the use of and the tri-modal (truck, train, and ship) standardization of containers soared. Even though the use of containers was also growing in the air freight industry, there was no standardization of these containers with the other modes of transportation.

2.1.3. Standardization of Surface Mode Containers

Primarily through the efforts of the International Organization for Standardization (ISO) and the American National Standards Institute (ANSI) there have evolved standards for intermodal containers. There will be no effort made here to discuss in detail these standards. Basically, however, these standards deal with dimensions, strength, and the corner fittings of containers. Figure 2.1 illustrates some of the standardized containers and Table 2.1 (ref. 4) summarizes basic data on them.

At present, in order to conform with ISO standards a container must be strong enough to be stacked six high and also be capable of withstanding the stress and strain of normal transportation conditions.

Figure 2.1 illustrates the corner fitting. For exact dimensions of the top and bottom corner fittings, one is referred to the ISO Draft Recommendation No. 1019, a copy of which may be found in Jane's Freight Containers 1969-70 (ref. 5). The corner fittings allow for standardization of container handling

Table 2.1

DATA ON STANDARD INTERMODAL CONTAINERS

External Dimensions meters (feet)	Material	Internal Volume m^3 (ft^3)	Payload Capacity kg (lb)	Tare Weight kg (lb)
2.44 x 2.44 x 3.05	Steel	15.0	8992.0	1340.0
(8 x 8 x 10)		(529.7)	(19,823.6)	(2954.2)
2.44 x 2.44 x 6.1	Steel	33.0	18,040.0	2280.0
(8 x 8 x 20)		(1165.3)	(39,770.7)	(5026.5)
2.44 x 2.44 x 6.1	Glassfibre/Steel	30.3	18,320.0	2000.0
(8 x 8 x 20)		(1069.9)	(40,388.0)	(4409.2)
2.44 x 2.44 x 6.1	Aluminum/Steel	31.0	18,643.0	1677.0
(8 x 8 x 20)		(1094.6)	(41,100.1)	(3697.1)
2.44 x 2.44 x 12.19	Steel	63.0	26,880.0	3600.0
(8 x 8 x 40)		(2224.6)	(59,259.3)	(7936.5)
2.44 x 2.44 x 12.19	Glassfibre/Steel	61.7	26,960.0	3520.0
(8 x 8 x 40)		(2178.7)	(59,435.6)	(7760.1)
2.44 x 2.44 x 12.18	Aluminum/Steel	63.0	27,229.0	3254.0
(8 x 8 x 40)		(2224.6)	(60,028.7)	(7173.7)
2.44 x 2.59 x 12.19	Steel	67.0	26,789.0	3682.0
(8 x 8.5 x 40)		(2365.8)	(59,058.6)	(8117.3)
2.44 x 2.59 x 12.19	Glassfibre/Steel	66.0	26,880.0	3600.0
(8 x 8.5 x 40)		(2330.5)	(59,259.3	(7936.5)
2.44 x 2.59 x 12.19	Aluminum/Steel	67.0	27,216.0	3266.0
(8 x 8.5 x 40)		(2365.8)	(60,000.0)	(7200.2)

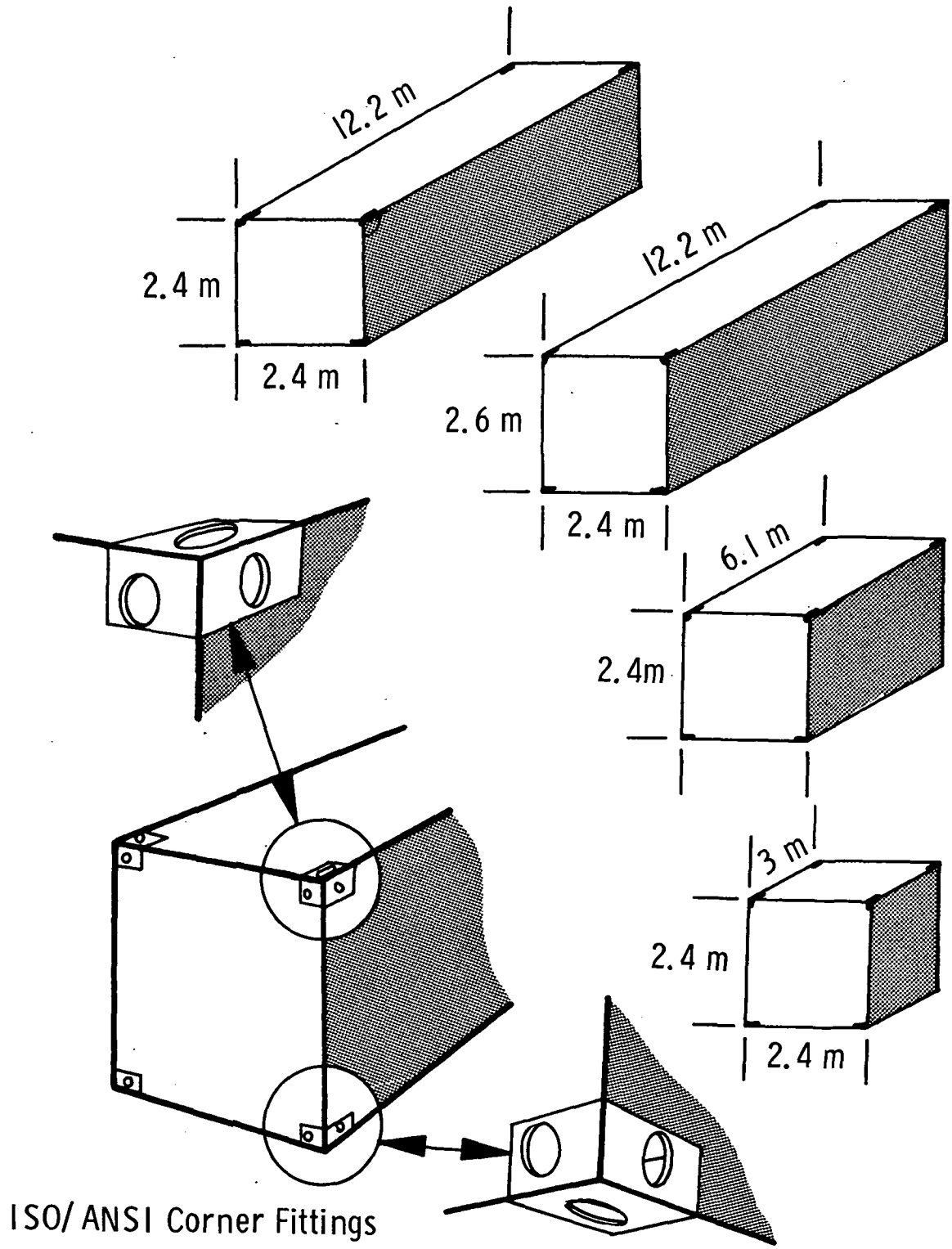

Figure 2.1 ISO/ANSI STANDARD CONTAINERS

equipment, storage equipment and tie-down fittings on the transport vehicles. Also, smaller length containers can be joined to make larger length containers. For example, joining two twenty foot containers to make an equivalent forty foot container can be done.

Even though much progress has been made toward standardizing containers, compliance with recommendations made by ISO, ANSI, and others is completely voluntary. There still exist some companies within the freight industry who do not conform to ISO standards. For example, Sea-land uses a non-standard 2.44m x 2.59m x 10.67m (8ft x 8.5ft x 35ft) container. Matson's containers are 2.44m x 2.59m x 7.32m (8ft x 8.5ft x 24ft).

2.1.4. Types, Materials, and Ownership of Surface Mode Containers

There seems to be an almost endless supply of different types of containers. Many of these containers exist for very specific needs. Generally, containers are rectangular with a width of 2.44m (8ft), a height of 1.22m, 2.44m, or 2.59m (4ft, 8ft, or 8.5ft) and a length of 3.05m, 6.1m, 7.32m, 9.14m, 10.67m, or 12.19m (10ft, 20ft, 24ft, 30ft, 35ft, or 40ft). Below are listed some of the container types presently available:

(1) Dry freight
(2) Open-top
(3) Insulated
(4) Refrigerated
(5) Tank
(6) Tilt
(7) Open-side
(8) Flat
(9) Half-height open-top
(10) Pressure tank

"The materials being offered in containers vary from ultraheavy to ultralight, and from ultrafragile to ultrastrong."(ref. 3) There are a number of factors which must be considered when choosing what material or combination of materials to use in constructing a container. These factors include strength, weight, cost, maintainability, working life, and corrosion and rust resistance. The following is a list of some of the materials that are used in the construction of containers:

(1) steel
(2) aluminum alloys
(3) glassfibre
(4) reinforced plywood
(5) reinforced plastic
(6) reinforced fiberglass
(7) composite
(8) balsa wood laminate

As one might suspect, a container represents a large investment. Depending on the material used in its construction, a twenty foot container can cost $3 000 or more. For the large volume shipper, such investments can often be justified. However, for smaller volume shippers owning their own containers is economically impossible. For these shippers, the answer is to lease or rent containers. The shipper may lease or rent a container from carriers, container manufacturers and/or container leasing companies. The arrangements and rates depend on such factors as length of lease, type and size of containers, and one way or round trip use.

2.1.5. Containerization in the Air Freight Industry

The use of containers in the air freight industry is not new. At present, it is estimated that between 30 and 35% of the revenue tonne-kilometers generated by domestic air freight is shipped in containers (ref. 6). This should not be surprising since the use of containers offer both the shipper and carrier advantages, such as:

(1) They greatly reduce the processing time by eliminating the verification, weighing, checking of labels, inspecting, etc. of many individual items.

(2) They greatly reduce the documentation required.

(3) They reduce the chance of pilferage.

(4) They reduce damage to the shipment. This includes ground handling, line haul, and weather damage.

(5) They eliminate the handling of the actual cargo at the air freight facility. Only the container is handled.

(6) They reduce the door-to-door shipping time.

(7) If the shipper loads the container and the receiver unloads it, additional cost savings can be achieved. A high volume shipper can also save money by purchasing his own container.

There are disadvantages of containers such as high initial cost, high maintenance cost, high tare weight, and increased storage space, but in general, the advantages outweigh the disadvantages.

By the mid 1960's, air freight containers had evolved into three basic sizes. They were called types A, B, and D. There were, however, a number of problems associated with these containers.

(1) They were not interchangeable among aircraft.

(2) They were large and hard for the shippers to handle.

(3) They were accessible only to jet airports since their contours fit only the jet freighters.

(4) They were expensive for the shippers to buy.

(5) They were fragile.

Since the average size shipment by air was 122kg (269lb) and 92% of the domestic air freight shipments were under 226.8kg (500lb) in 1974 (ref. 7), the air freight industry developed the smaller type Q and E containers in order to meet the shipper's needs. These containers were also much easier to handle.

During the development of the air freight containers, no effort was made to make them compatible with surface transportation. In more recent years, there has been an effort to develop and use containers that are compatible with the surface mode, especially trucks. At present, there are two sizes of rectangular container used in the air freight industry, the M-1 and the M-2. The M-1 is 2.44m x 2.44m x 3.05m (8ft x 8ft x 10ft) and the M-2 is 2.44m x 2.44m x 6.1m (8ft x 8ft x 20ft). Some of the current road blocks in developing air containers that are totally compatible with the surface modes are:

(1) Tare weight: in order to have the strength necessary to stack containers six high on containerships, the containers must be constructed of materials which cause high tare weights and are thus undesirable for air freight purposes.

(2) The ribbed construction of the bottoms of surface containers make them incompatible with the roller conveyor systems used to load and unload aircraft. These containers may be placed on pallets and rolled in and out of the aircraft but this increases tare weight.

(3) The corner fittings of surface containers often protrude from the container bottom up to .02m (3/4in) which cause overload conditions for the floor of the aircraft (ref. 8).

(4) There are only a few commercial aircraft capable of handling 2.44m x 2.44m (8ft x 8ft) containers.

(5) Current air freight demand is not sufficient to justify the use of large rectangular containers nor to justify the purchase of airplanes that can carry them.

There are efforts currently under way by several organizations to standardize air freight containers. Both the Air Transport Association (ATA) and the International Air Transport Association (IATA) are working to standardize containers within the air freight industry. This effort has met with some success. There are a number of containers which have been standardized to make them interchangeable among the widebody aircraft: B-747, DC-10, L-1011, and A-300. However, there still exist some containers which are specifically designed for a particular aircraft. For example, the LD-1 container fits only in the B-747.

An effort is also underway by these same two organization, along with ISO, ANSI, and SAE (Society of Automotive Engineers), to develop standards for the rectangular intermodal containers. This effort has led to the designation of the M-1 and M-2 containers. These containers are quad-mode (air, rail, truck, ship) containers but are capable of being stacked only two high instead of the ISO/ANSI standard of six high.

2.1.6. Types, Materials, and Ownership of Air Freight Containers

As was alluded to in the previous section, there are a number of different types of containers used in the air freight industry. Figure 2.2 illustrates some of these containers and Table 2.2 summarizes specific data for them.

Tare weight of the air freight container is a very important factor in the selection of construction material for the container. An effort is made to achieve a tare weight of less than 24kg/m^3 (1.5lb/ft^3) (ref. 3). At present, air freight containers are made of materials ranging from corrugated cardboard to steel. However, in order to achieve high strength and low tare weight, the industry has turned to containers made of composite materials, such as balsa wood laminate, reinforced fiberglass, reinforced plastics, and aluminum alloys. Containers with a tare weight of 21.15kg/m^3 (1.32lb/ft^3) and with good strength characteristics have been obtained.

The M-2 container which is intermodal (except for stacking limitations) has the ISO/ANSI corner fittings and a smooth, flat undersurface for interface with the roller system of loader and airplane (ref. 9). It weighs approximately 988kg (2200lb) and cost approximately $8500. (This is half the weight and three to four times the cost of the same size ISO marine container.) This container achieves a tare weight of 27.5kg/m^3 (1.72lb/ft^3) which is approximately half the 54.4kg/m^3 (3.4lb/ft^3) achieved by ISO marine containers.

As was the case with surface container ownership, air freight containers may be owned by the shipper, the airlines, or a leasing company. In general, the larger containers (types A, LD3, LD7, LD11, M-1, M-2) are owned or leased by the airline and the smaller containers (types B, D, Q, E) are owned or leased by the shipper. In general, the larger containers mentioned above do not require additional processing by the carrier if loaded by the shipper since they are air-worthy. This is not the case for the smaller containers.

2.1.7. Cube Utilization

Cube utilization or stacking efficiency (ref. 11) has been a driving force in moving the air freight industry away from pallets and toward containers. Cube utilization is defined as "the percentage of the interior volume of a container that is actually taken up by the packages stowed within." (ref. 12) The lack of high cube utilization is a major contributing cause to the fact that the freight airplane usually cubes-out before it weighs-out. Simply put, this means that the cargo is not of sufficient density to fully utilize the airplane's weight carrying capability. There are two ways to prevent the cube-out problem. One way is to increase the average density of the cargo carried. However, in a 1968-69 international survey, Douglas (ref. 12) found that the average density of a cargo package was 229kg/m^3 (14.3lb/ft^3). Since the shipper decides what to ship by air and since the air freight industry is not in a position to be particular about what they accept for cargo, there is little chance that the density of the cargo shipped by air can be increased by the air freight industry.

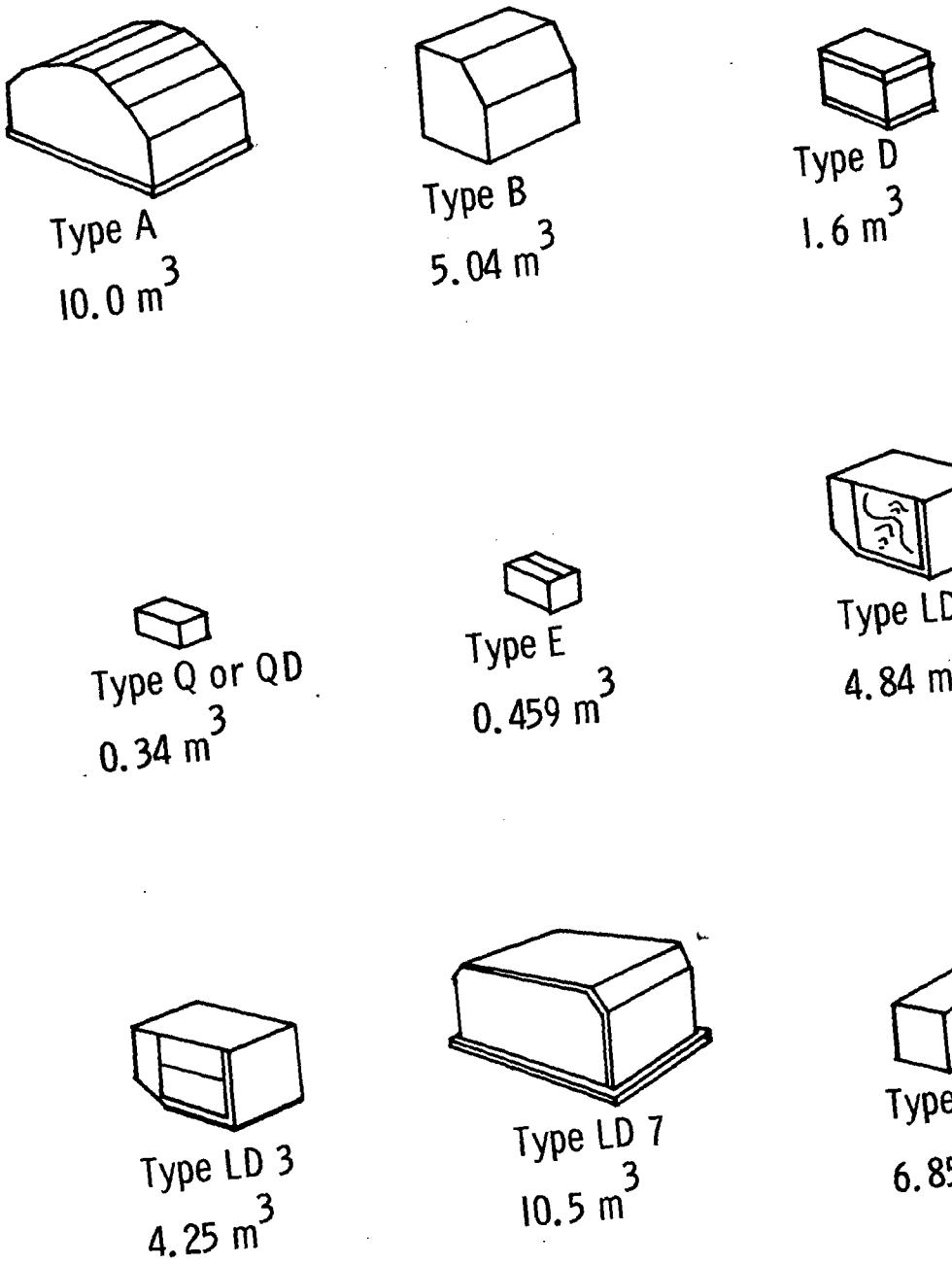

Figure 2.2 AIR FREIGHT CONTAINERS

Table 2.2

DATE ON AIR FREIGHT CONTAINERS

Container Type	Length m (inches)	Width m (inches)	Height m (inches)	Internal Volume m^3 (ft^3)	Tare Weight kg (lb)	Cargo Weight kg (lb)
A	3.02	2.13	1.93-1.22	10.08	258.6	3175.2
	(119)	(84)	(76-48)	(356)	(570)	(7000)
B	2.13	1.47	1.93-1.14	5.04	149.7	1587.6
	(84)	(58)	(76-45)	(178)	(330)	(3500)
D	1.07	1.47	1.14	1.61	68.0	907.2
	(42)	(58)	(45)	(57)	(150)	(2000)
Q or QD	1.00	0.70	0.53	0.34	18.1	181.4
	(39.5)	(27.5)	(21)	(12)	(40)	(400)
E	1.07	0.74	0.65	0.46	22.7	226.8
	(42)	(29)	(25.5)	(16.2)	(50)	(500)
LD-1	2.34-1.56	1.52	1.63	4.84	124.7	1159.0
	(92-61.5)	(60)	(64)	(171)	(275)	(2555)
LD-3	1.91-1.47	1.45	1.50	4.25	167.8	1406.2
	(75-58)	(57)	(59)	(150)	(370)	(3100)
LD-7	3.18	2.24	1.60	10.48	117.9	4445.3
	(125)	(88)	(63)	(370)	(260)	(9800)
LD-11	3.18	1.52	1.63	6.85	167.8	2993.8
	(125)	(60)	(64)	(242)	(370)	(6600)

The second method of preventing the cube-out problem is to increase cube utilization. In the same 1968-69 survey previously mentioned, Douglas found that average cube utilization was about 54%. There were two prime reasons for this result. First, there is a lack of cargo in some cases to sufficiently load pallets and/or containers. This problem can only be solved by a better marketing and sales program. The second reason is the use of pallets which tend to be packed inefficiently in the vertical dimension. The use of containers can solve this problem. It has been demonstrated that containers can achieve cube utilizations between 88 and 93% (ref. 13).

Even though there is substantial use of containers in the air freight industry, most of them are contoured instead of rectangular containers. The contoured containers are specifically designed to conform to the inside shape of the airplane, thereby more fully utilizing the available volume of the airplane. However, there are three distinct disadvantages of using contoured versus rectangular containers. They are:

(1) Contoured containers cost more per cubic meter of volume than do rectangular containers (ref. 12).

(2) A contoured container is less efficient (based on cube utilization) than a rectangular container. For example, for a rectangular and contoured container each of 12.74m^3 (450ft^3) volume, the contoured container is about 2.5% less efficient (ref. 12).

(3) Contoured containers are sometimes designed and built for a specific airplane which restricts the intramodal use of these containers.

2.1.8. Rectangular Container Capability of Current Aircraft

The introduction of the widebody airplane in the early 1970's was the start of a new era in the air freight industry. These aircraft were capable of carrying much more freight than the narrowbody airplane. For example, the four engine narrowbody airplane can carry 33 294-46 448kg (36.7-51.2tons) of cargo (9 435kg if carrying a full complement of passengers) while the four engine widebody airplane is capable of 113 036-119 023kg (124.6-131.2tons; 26 339kg with passengers (ref. 7)).

There are four widebody aircraft on the commercial market today. They are the B-747, the DC-10, the L-1011, and the A-300. At present there is only one widebody freighter, the B-747-F. Each of the widebody passenger aircraft is capable of carrying considerable freight. In general, this freight is containerized in the LD type containers. The cargo for these aircraft is side door loaded. The passenger aircraft, in general, do not have the capability to carry 2.44m x 2.44m (8ft x 8ft) containers.

The nose loading B-747-F is capable of handling the M-1 and M-2 containers and also the 2.44m x 2.44m x 12.19m (8ft x 8ft x 40ft) containers. The only other commercial aircraft with this capability is the L-100.

The B-747-F is the largest commercial freighter available today. It is capable of carrying up to 117 936kg (260 000lb) of cargo (ref. 7). In terms of rectangular containers, the B-747-F can handle the following maindeck configurations (ref. 14):

(1) Thirteen 2.44m x 2.44m x 6.1m (8ft x 8ft x 20ft) and four 2.44m x 2.44m x 3.05m (8ft x 8ft x 10ft) containers.

(2) Five 2.44m x 2.44m x 12.19m (8ft x 8ft x 40ft) and ten 2.44m x 2.44m x 3.05m (8ft x 8ft x 10ft) containers.

This airplane is limited to carrying containers with heights of not more than 2.44m (8ft). At present, approximately 97% of the domestic inventory of intermodal 12.19m (40ft) long containers are over 2.44m (8ft) in height. For the 6.1m (20ft) containers, there are approximately 47% over 2.44m (8ft) and this percentage is increasing at a rapid rate (ref. 10). These trends could hinder the intermodal capability of the air freight industry in the future unless new aircraft are designed to handle the taller containers.

A recent industry/government effort was made to demonstrate that air transportation could be completely compatible with surface transportation. The effort was led by the Lockheed-Georgia Company and was named Intermodal Air Cargo Test or Project Intact (ref. 2). The Air Force's C-5 Transport was used in the demonstration. Rectangular containers conforming to ISO/ANSI standards were used. The containers were 2.44m (8ft) wide, ranged in height from 2.44m to 4.12m (8ft to 13.5ft) and were either 12.19m or 13.72m (40ft or 45ft) long. On one demonstration flight, the airplane carried six 2.44m x 2.59m x 12.19m (8ft x 8ft x 40ft) containers. It should be noted that the airplane weighed-out instead of the usual cube-out situation.

There are presently four air carriers who offer the M-2 container to their customers. They are Seaboard World, Lufthansa, American, and Air France. There are some 400 of the M-2 containers in use today (ref. 10). There is still not a substantial volume of air cargo moving by the M-2 container, however, during the period October 20, 1976 to December 23, 1976, Seaboard World moved 963 M-2 containers between the United States and Europe (ref. 10).

2.1.9. Summary

Approximately 80% of the air freight being hauled today is either emergency shipments or physically or economically perishable commodities (refs. 7, 15). Air Cargo is primarily small packages and has a high dollar value (ref. 2). In 1976, of the approximately 24.9 billion revenue-tonne-kilometers (17.1 billion revenue-ton-miles) flown, about half went as belly cargo in passenger aircraft (ref. 14). The remaining half went to all freight aircraft. This volume is insufficient to justify many of the intermodal container concepts. The present air cargo markets are already well developed and offer little hope of substantial volume increase. New markets must be obtained. This can be done by becoming more cost competitive. One of the ways to become more cost competitive is for the air freight industry to develop intermodal capabilities. This will lead to a more integrated transportation system which will use standardized containers. The use of the standardized containers could well be

a driving force in obtaining realization of regulations imposed by world government which presently hinder good door-to-door service (ref. 3).

The bottom line is that through the use of intermodal containers, the air freight industry can become a high volume business which is economically viable, and still provide the customer with a fast, reliable, door-to-door service.

2.2 INTERMODAL ACCESS

Currently cargo arrives at freight terminals in packages or air containers. Intermodal containers of the 6.1m variety will be an addition to this mix. The access routes to and staging areas of terminals must be modified to handle the new array of vehicles which will carry cargo to the airport. The essential difference between existing terminals and those of 1990 will be the capacity to handle intermodal containers. Other problems are similar in type to those handled at present facilities; they are likely to grow as the amount of air cargo grows. Currently the only direct access provided is to trucks, the trucks often sharing major routes with automobiles. In general, the research on terminal accessibility has been limited to passenger traffic (refs. 16, 17, 18, 19, 20).

This section has four major purposes: 1) to consider the types of access required by surface modes in ACIS; 2) to consider the concepts by which this access might be provided; 3) to consider the effects of terminal configuration on access; and 4) to consider the effects of joint military/civilian use of cargo terminals on access alternatives.

2.2.1. Contemporary and Advanced Surface Modes

The four surface modes are trucking, rail, water, and pipeline. They are compatible with air transport in varying degrees. Part of the degree of compatibility pertains to the type of cargo for which each mode has inherent advantages. The greater the emphasis on bulk cargo, the less the compatibility with air carriage. Thus, rail, water, and pipeline have often been summarily dismissed as not needing air terminal access. While this is justified under current operations, some innovations may change this condition; in addition, there are some proposed intermodal hauls using air which require a better physical interface. Thus trucking will be considered on the near horizon and throughout our planning period of 1990-2015, while other modes are considered to have possible effects on the far one.

2.2.1.1. Trucking Access

Trucking access is and will be provided by highways. The major question here is how exclusive it should be. At most local (feeder) airports, the air cargo facility, if there is even a separate structure, is reached by the same roads as the passenger terminal. In some instances, a truck whose destination is the cargo terminal must pass through the entire passenger area before it arrives at the cargo gate.

Minor hub airports which, as in the feeders, have fairly simple on-facility highway networks, generally use these networks for moving both people and freight. There may be a specific turnoff to the air terminal and some staging area for trucks, however even then the primary emphasis is convenience

for personal vehicles and parking. In some instances, separate exits and access roads are provided from interstates for those with cargo terminal business. Major hub airports have separate cargo areas, hence connecting roads on the site are to some degree exclusive. Many have air exclusive cargo terminal exits from interstates or other limited-access highways leading to the facility.

The quick movement of cargo is enhanced with the exclusiveness of the cargo access routes. Trucks do not add to, nor are they caught in, congestion generated from passenger-related traffic. Clearly the greatest contributor to congestion is passenger and passenger related traffic. Access for thousands and tens-of-thousands of automobiles is a common requirement at hub airports. On the other hand, a cargo terminal with 180 tonnes per day capacity -- the volume of traffic at a minor hub -- may expect to receive only 65 trucks per day (ref. 21). While some peak-hour congestion around hubs may develop even with exclusive access roads, the problem is less severe.

2.2.1.2. Rail Access

With contemporary systems, rail access is not usually required for domestic movements. In general, commodities which can tolerate the low speed of rail transport do not need the special time advantages of air freight. The added cost is, therefore, not acceptable.

There are some international movements involving rail that, at present, do not incorporate a direct rail-air interface but could. For example, if a company in Kansas has six 6.1m (20ft) containers of their product to be exported to Japan, it is likely to travel Container On Flatcar (COFC) to a West Coast port and there be shifted to a containership, with short truck movements to connecting end point terminals. If this cargo is air eligible, a spur to the air terminal with direct transfer to a plane would facilitate the movement and increase the probability of air freight being selected for the transoceanic leg of the trip.

Currently such a movement would require trucking the containers from the railyard to the airport, stripping them, restuffing cargo into air containers, and loading the containers on a plane. This handling would probably make the air option both inconvenient and expensive. Simple transfer from a rail spur would make air transportation more competitive. However, a regular and relatively high volume of traffic would be needed to support the tracks. They would be located only at the largest hubs, probably with a coastal location.

At least one future rail concept might efficiently use access to air cargo terminals, the TRAILS system (ref. 22). TRAILS is designed to carry high value, low density cargo in small loads (39 tonnes or less) at average speed of 5.374m/s (120mi/h). It would obviously be competitive with domestic airlines for cargo, however, it may be complementary with major international hubs for single waybill movements of overseas cargos. Currently, the TRAILS system is conceived to use standard gauge track, with rationalized vehicles, and be routed in the medians of interstate highways.

Though it is questionable that such a system will ever be constructed, there will undoubtedly be some renovation and changes in operating procedures which will allow for faster and/or express COFC service between points with rail terminals. Some provision for rail access to international airports may be appropriate for both cargo and passenger traffic, if rail service is improved and highway transportation becomes more costly.

2.2.1.3. Water Access

There is no need for interface between inland waterway and air cargo facilities. The types of cargo moved in the two modes are not compatible. If an "air bridge" concept (ref. 23) is put into operation, there may be some consideration given to ocean-going container docks on the airport site for direct transfer of containers. An intermediate truck link, however, is more feasible. The container docks could not be justified even accepting stupendously high estimates of air bridge traffic. It remains that no direct access is needed for waterborne commerce.

2.2.1.4. Pipeline Access

Again, the types of cargo which traditionally move in pipeline are not compatible with the air mode. As long as liquid bulks and gases remain the major cargos, this condition is not likely to change. Some have suggested either pneumatic or hydraulic tubes for the surface transport of modules with air eligible cargo.(ref. 22) The implementation of either of these innovations would be at the end of the planning time period at the earliest, hence it is not envisioned that pipeline access to air cargo terminals should be provided, with one exception. If a terminal configuration which involves breakdown and assembly of local traffic at a remote site is selected, some sort of tube connecting the on- and off-site facilities may be feasible. This, however, is not an access problem. It is one of the terminal design.

2.2.1.5. Summary

It remains that the major ground mode of transportation needing access to air cargo terminals over the period 1990-2015 is trucking. The nature of rigs is expected to change from semi-trailers to two and three trailer types in interstate trucking by 1990 (ref. 22). This will call for some access road and staging area design modification, but the predominant interface with trucking persists.

Some interface with rails for COFC or TRAILS cargo may be needed for direct international movement at major hubs. This still is likely to constitute a small proportion of air traffic and a small space dedication in the total terminal.

2.2.2. Access Design Concepts

There are two basic access design concepts: 1) on-port access only, and 2) on-port and subsidiary terminal access. The subsidiary terminal configuration alternative pertains only to local trucking traffic. Clearly the

container transfer among planes would not be facilitated by an off-site subsidiary station.

2.2.2.1. Concept Alternatives for Trucking

Terminals can take two basic configurations on port: 1) a single building, or 2) gate arrival terminals (ref. 24). The primary advantage in gate arrivals, assuming they are assigned by region of destination, is a forced sorting of cargo before it arrives at the terminal. This saves at least a general destination classification on the premises. In physical structure and operation, these gate terminals do not vary widely from a normal terminal. They are, however, scaled down in size to the smaller proportion of cargo which will pass through each facility with the associated diseconomies of scale.

Access objectives are similar in each case. First, the staging area and bays must allow for manuvering vehicles, dropping trailers, and transferring containers. Second, there must be adequate space for queuing of vehicles. Their arrival is a random process, hence queuing space must be geared to peak possibilities to avoid periodic congestion of access routes. Third, there must be an adequate number of bays to minimize queuing in staging area. Fourth, delays due to congestion in access routes should be minimized.

2.2.2.2. Staging and Bay Design Requirements

The nature and size of staging areas required for the types of cargo moved in an advanced system would vary by airport classification, i.e., hub, minor hub, or local airport. A hub is viewed to be a major origin and destination for domestic and international cargos as well as an important transshipment point. A minor hub is a substantial traffic generator with some transshipment, primarily in package cargo. A local airport is a generator, usually minor, of traffic. It does limited sorting and no consolidation.

2.2.2.3. Major Hubs

Considerably greater truck staging area than exists in current designs will probably be necessary for hub terminals in the 1990 advanced system. Maintaining the assumptions that substantial line-haul trucking will be done in double- and triple-rigs and recognizing that major hubs will generate foreign and domestic traffic from fairly large catchment areas, it follows the direct terminal access for the doubles and triples is desirable. Because the trailers must be dropped and brought to bays or other cargo handling areas one at a time, both larger and differently aligned staging areas are required compared to those for semi-trailers.

The triple-rigs would be the largest access vehicles expected. Most vehicles going to the cargo bays in the package terminal would remain local delivery trucks. The current estimate of 558kg (1230lb) payload per truck entering or leaving cargo terminals would probably apply to these vehicles. Double- and triple-rigs would carry substantially higher payloads. A 180 tonne terminal, one large enough to handle the full volume of a domestic hub

or each of several carriers in a hub with international traffic, could handle 624 vehicles in the bays in a 24-hour period.

This assumes 13 bays in the covered package area and an average of one-half hour in a bay for each vehicle. Assuming a 2300 to 700 hour curfew on aircraft take-offs and landings at the airport, hence a 600 to 2400 hour operation of the terminal, 468 trucks carrying traditional package cargo could be handled at the terminal building. Current designs for terminals of this 180 tonne average capacity include 13-16 cargo bays (ref. 21), hence would need no modification to conform to this projection. Holding area, however, may be limited to as few as three additional parking places for 12.2m (40ft) semi-trailers. This holding area is approximately 166m^2 and is inadequate for the size and operation of double- and triple-rigs.

Because the multi-trailer rigs must drop all but one of their elements to maneuver into bays, there is at least one trailer in holding for every one being stripped or stuffed. Thus it is conceivable that a holding space will be required for each bay in addition to those spaces for rigs which have no elements in the bay. Each of these spaces will occupy a greater area than those designed for semi-trailers. In addition, queuing space will be needed for the local delivery trucks.

The holding area needed for trucks alone should be 540m^2. This amount of space would allow for holding 48 triple-rigs, or more vehicles of smaller sizes. This is approximately three times the area of the bay space plus three overflow parking places. It would be possible to have 13 triple-rigs being loaded or unloaded and 13 full plus 13 empty ones in queue.

Space for a 6.1m intermodal container operation must also be provided. Current maritime container facilities have about 81 000m^2 reserved for each container berth. This, again, follows the rule of holding three times the capacity load of associated container ships and provides working space and full plus empty container holding areas. Nowhere near this allocation will be required on an air terminal, because the capacity of an air freighter is so much lower than that of a containership. Allowing for a possible load of 18 of the 6.1m (20ft) boxes in a Boeing 747-11F/111F,(ref. 23, 25) the largest proposed incremental improvement in craft size over current wide-bodies, 8100m^2 would be a generous allowance of staging area for such cargo needs. This would include the storage for equipment, space for the bay, and a truck holding area. It is approximately five times the space needed for the load from a single craft.

Gross staging area, not counting terminal structure bays, can then be expected to be on the order of 8600m^2 to accomodate the interstate truck of the 1990's. This is a spectacular increase in open storage and holding area. There is also some inherent overcapacity. The payload of a single 747-11F/111F would be on the order of 110 tonnes, 77 in the main deck containers, and 33 in the belly. This assumes an average cargo density of 107.3kg/m^3, and is posited on a trans-United States or East Coast U.S. flight to Europe with a craft whose capacity is 130.5 tonnes at that stage length. All cargo is containerized with 9 standard intermodal 6.1m boxes, 9 M-2 intermodal containers, 4 of

the 3.05m boxes, and 40 LD-1 type belly pods. The payload of two dedicated flights would exceed the average daily volume of the covered facility. Such a terminal would probably be minimal to allow maneuvering and avoid the queuing problems associated with access, however, it would be capable of handling substantially greater volumes if containerized service was highly successful. Eight such flights daily would allow the processing of approximately 880 tonnes of containerized freight, 265 of which would be in the belly.

The belly containers could derive from package cargo which has been consolidated on- or off-site. These would be processed through the regular terminal structure, hence holding space for cargo or trucks accessing it would not be needed at the intermodal container berth. Most of the 6.1m containers would arrive two at a time on flatbed trucks; an average of two per vehicle can be assumed. A 24-hour operation with two hour turnaround for the aircraft, i.e., two hours to strip, stuff, and fuel the craft, would generate 216 trucks. Holding area for vehicles would be provided for within the 8100m^2. In a major hub port, several carriers may require this sort of minimal holding and staging area. Considerable construction cost and ground area might be saved if a number of terminals used common staging areas. This would also mitigate the extensive overcapacity.

Finally, some provision for parking for those sending and receiving freight is necessary. Forwarders, brokers, and other principals will need to be on site for customs and to receive cargo in major hubs. Small package pick-ups and drops may be done by personal vehicles. The amount of space needed for parking depends greatly on the local infrastructure and volume of traffic hence will not be detailed here. The space required will increase as the number of shippers and intermediaries grows.

Some special consideration may be needed in terminal design for increased volumes of cargo which has been consolidated into belly containers off the port by forwarders. As was noted earlier, freighters which are designed to move the 6.1m intermodal container also have considerable belly hold capacity. Both increases in large dedicated freight and in passenger fleets result in increases in belly cargo capacity; hence the total space available for cargo in the belly holds will almost certainly increase at greater rates than that for cargo above decks.

Forwarders who handle small lots are likely to take advantage of this condition. The LD-1 containers, used in the earlier computations, can carry approximately 540kg (1200lb) of cargo at 107.3kg/m^3. Using these containers for small lots would avoid waiting to fill a full 6.1m box, and hence expedite service. Assuming 40 percent of the traffic continues to derive from forwarders, increased handling of full belly containers can be anticipated. Special bays for the receipt and delivery of them will facilitate access and operations.

2.2.2.4. Other Mode Access for Major Hubs

Trucking and rail are the only two modes which would require direct access to terminals in the 1990 period. Accepting the premise that double-and

triple-trailers will be handled directly from interstate highways, the need for the earliest possible separation of trucks from passenger terminal traffic is emphasized in hub ports. The traffic capacity of these freight access roadways would vary according to the total airport traffic, the exact terminal configuration, and the mix of intermodal containers compared to other types of cargo. Using the figures calculated for the earlier analysis, a 24-hour capacity operation would generate 840 trucks, 216 of which would be at least semi-trailers. This is an average of 35 vehicles per hour (this rate is the same for the curfew-limited example). Personal automobiles with business at the terminal would also add to the load. A two-lane, two-way highway would be adequate to handle this sort of load with terminal staging of the type outlined above. At a major hub, where ten or twenty such terminals might exist, a four-lane road would be necessary.

For rail, a single track with three spurs should be adequate to handle any anticipated needs. Each spur should hold 4 to 6 COFC, the approximate payload of a large dedicated freighter. This configuration follows the marine berth storage capacity of three times the containers in a single vessel. Insofar as airports are located some distance from switchyards or mainlines, there may be problems encountered in acquiring the right-of-way for a rail spur.

2.2.2.5. Minor Hubs and Local (Feeder) Airports

No substantial changes in access links and staging areas are needed to install the 1990 advanced system where most minor hubs and local airports are concerned. Localized assembly and distribution will still be by truck, and the trucks involved will not be the double- and triple-trailer interstate rigs. While some volume increases, hence terminal expansion, can be anticipated, the basic access rights-of-way and staging areas can remain as they are in higher volume cargo ports of today. The single exception would be a terminal which originates a regular container traffic. Here container handling equipment and holding would have to be provided. Few of the minor hubs or locals would have this traffic.

2.2.2.6. Off-Site Assembly and Distribution

The development of satellite terminals for local assembly and distribution of goods must be considered in the light of scale economics of terminal size. The off-site terminals do not eliminate the need for on-site facilities, they merely modify the latter to container processing terminals with regard to localized traffic. The on-site terminal at hubs must still consolidate and breakdown cargo for transshipments. With hubs, then, both the on- and off-site facilities do assembly and breakdown of cargo; in addition, the on-site terminal processes full containers.

Only in local terminals could the port and satellite stations have distinct operational characteristics. In this instance, however, it is unlikely that the volume of traffic would justify specialization of function and ground crews. In hub ports, since the on-site crews will have to perform all the functions of off-site ones plus more, the feasibility of a satellite is based

on the volume of local traffic as a proportion of total traffic. If the transshipment far exceeds the local traffic, all cargo should probably be handled on-site, otherwise there are strong possibilities of overcapacity, i.e., inefficiently used labor, at the port.

Before a remote assembly point should be considered, the volume of local traffic needs to be high enough in itself to justify a terminal, and the ratio of local to transshipped traffic should be high. There is also an additional transfer cost from the satellite to the main terminal which must be integrated into the costs of such an operation. Finally the location of the remote terminal must be selected.

Algorithms have been proposed for this location problem (ref. 26), and there are a variety of general location-allocation techniques which pertain. Terminals could be located to minimize total surface transportation costs or time to trucks, to equalize surface transport costs or time to consumers, to minimize the cost or time to the most remote consumer, or to satisfy other criteria. Some algorithms incorporate established networks; others assume direct point-to-point travel. All allow that any location within the space delimited is eligible for terminal placement.

In reality, there are considerably fewer possible sites for a remote terminal. The possible locations are limited by zoning. Such a terminal could be in only those classifications in which industrial activities are permitted. In all likelihood, old interior manufacturing districts would have considerable access and internal circulation problems, hence would be unsuited to a freight terminal. Planned manufacturing/distribution parks tend to be located on the fringes of the urban area with convenient access to interstate highways. Thus an assembly point on the airport itself would be as attractive for cost minimization as one in a new industrial park. It is highly unlikely that satellite terminals will be a practical feasibility for any single airline.

2.2.2.7. Gate Arrival Terminals

The primary problem with gate arrival terminals is the abrogation of scale economies in operations. They could be feasible only at high volume major hubs even with an expanded 1990 traffic. Further, if it is assumed airlines that will maintain separate terminals, even the major carriers do not have, and are not likely to have by 1990, the volume of traffic to justify gate arrival terminals. Gate arrival terminals would have to be used commonly by all lines to be feasible. While gate arrivals pose no particular problems for access to other modes, they are an alternative which is highly unlikely due to institutional constraints.

2.2.2.8. Access at Joint Civilian/Military Ports

The same modes would require access by the same means to airports handling joint civilian/military and civilian cargos. In some sense, the problem is minimized if military ports are used for dedicated air cargo movements. There would be no overlap with commercial passenger access. On the other hand, many

of the possible military bases for such joint use do not have the interstate and rail links needed for hub traffic. The role of such places would be to facilitate large local movements, possibly from a limited number of firms.

Using civilian airports for the loading of most routine military shipments in the United States implies no unusual access problems. However, the shipment of outsized military cargos would call for special load capacities in holding areas and on access roads. Civilian air shipment of such cargo cannot be expected to justify these additional requirements. Hence there are some access limitations on both the civilian use of military airports and the military cargos which might move through civilian airports.

Using military airports as all freight operations creates a considerable problem of interface between the cargo system and small package and belly pod traffic which originates from passenger flights. This same problem exists if any dedicated freightports are established.

2.3 TERMINAL OPERATION

A very important element in the proposed air cargo system is the airport terminal. Most of the transit time for the majority of door-to-door air cargo shipments is used on the ground and hence the weak link in improving overall service is the ground support system. The main objective of the terminal operations, then, is to achieve time savings and incidently lower the packaging costs, better the protection of the goods, and better intermodal exchange. This requires the introduction of automation and mechanization particularly in those elements of the terminal where cargo is loaded, unloaded, and moves on the ground. It also requires streamlining the consolidaton and break down operations and moving them to the ends of the distribution system, preferably to the locations of the consignor and consignee.

The terminal receives small loads, consolidates these into large unit loads which are then loaded onto the transport aircraft. On off-loading the aircraft, the terminal also receives large unit loads which are then broken down into individual parcels for delivery to the customers. Planning for the air cargo terminal then is like planning for any freight processing facility except that the large tracts of land required come from usually expensive airport land. As air cargo continues to grow in importance, the surface vehicular traffic accompanying a large volume of air cargo will require careful planning as already mentioned.

Air cargo facilities are influenced by many other factors such as surface access, the split between full freight and belly cargo, aircraft types, the split between domestic and international cargo, types of cargo, cargo handling and storage, volume of cargo, intermodal containers, the information and documentation process, airport capacity, and existing passenger traffic. This section considers four major questions for terminals of the integrated cargo system proposed:

1) Where should the cargo terminal be located?

2) What size should it have?

3) What should the design look like?

4) What loading facilities and equipment are required?

2.3.1. Locations of the Terminal

Where should the cargo terminal be? Again, many factors influence this decision, such as an existing airport versus a new airport, surface access, runway access, location of the passenger terminal, zoning criteria. The limited capacity of existing airports can be increased if certified freight forwarders handle a larger share of the small package traffic and move their assembly/disassembly areas away from the airport. The problems of the vehicular traffic associated with the forecasted growth in cargo volume will tend to

reinforce this trend to off-airport consolidation. Direct access from the runways to the cargo terminal for the aircraft and transit ways from the passenger terminal(s) to the cargo terminal(s) must be provided. Belly cargo will account for 50% of total cargo making the transferability from the passenger terminal to the freight terminal of considerable importance.

2.3.2. Size of the Terminal

How large should the cargo terminal be? That depends on many factors, such as cargo tonnage projection, airport capacity restrictions, containerized cargo storage requirements, livestock, mail, staging area, consolidation space, express service, security, and automation of cargo handling systems. The prime objective of air carriers is to fill their aircraft and this objective would be advanced by offering favorable bulk rates to forwarders, hence diminishing their own small package business. Rather than develop off-airport cargo handling facilities, they should make it clear that shipping small packages via forwarders saves time and money. A containerized system would require a proportionately smaller cargo terminal although this may be offset by the penetration into less time sensitive products requiring greater storage on the terminal. One LCA requires 10 000m2 of floor space, hence a two dock operation would require at least double that area. Storage time must be cut to a minimum to maintain these space estimates, thus the interface with the trucking at the terminal will be critical. High rise storage seems the only other alternative to devoting massive proportions of the total airport to freight terminals, if transfer cannot be effected with speed.

2.3.3. Design of the Terminal

The design of future cargo terminals depends on factors such as aircraft design, the degree of mechanization and automation in cargo handling, the degree of computer control over information and documentation, and the degree of containerization. The greatest impact on the design of the interface between the cargo terminal and the aircraft is due to the introduction of the large nose loader specifically designed to carry freight. Currently civilian freighters are almost all modified passenger aircraft. The terminal must be completely mechanized to bring the containers from the truck to the loading device of the aircraft, and computers, real time teleprocessing ones, must eliminate the paper work and decisions which tend to staff a smooth flow. Momentary storage by destination in between arrivals and departures of aircraft can be handled by the same computer.

Figure 2.3 illustrates the layout of the terminal. As was pointed out in the section on rail access, there is at present no true intermodality between rail container and aircraft. This makes the air option both inconvenient and expensive. For efficiency with large volumes of air cargo, the container used therein must eventually become intermodal. In the mean time, for true intermodality, an "auxiliary" tray system is suggested in which the ISO/ANSI container with its ribbed bottom and protruding corner posts is set in a tray at the cargo terminal and automatically locked in place. The system would incorporate fixed overhead cranes to move containers from flatbeds onto terminal conveyers. At the conveyer interface, there would be a guide structure

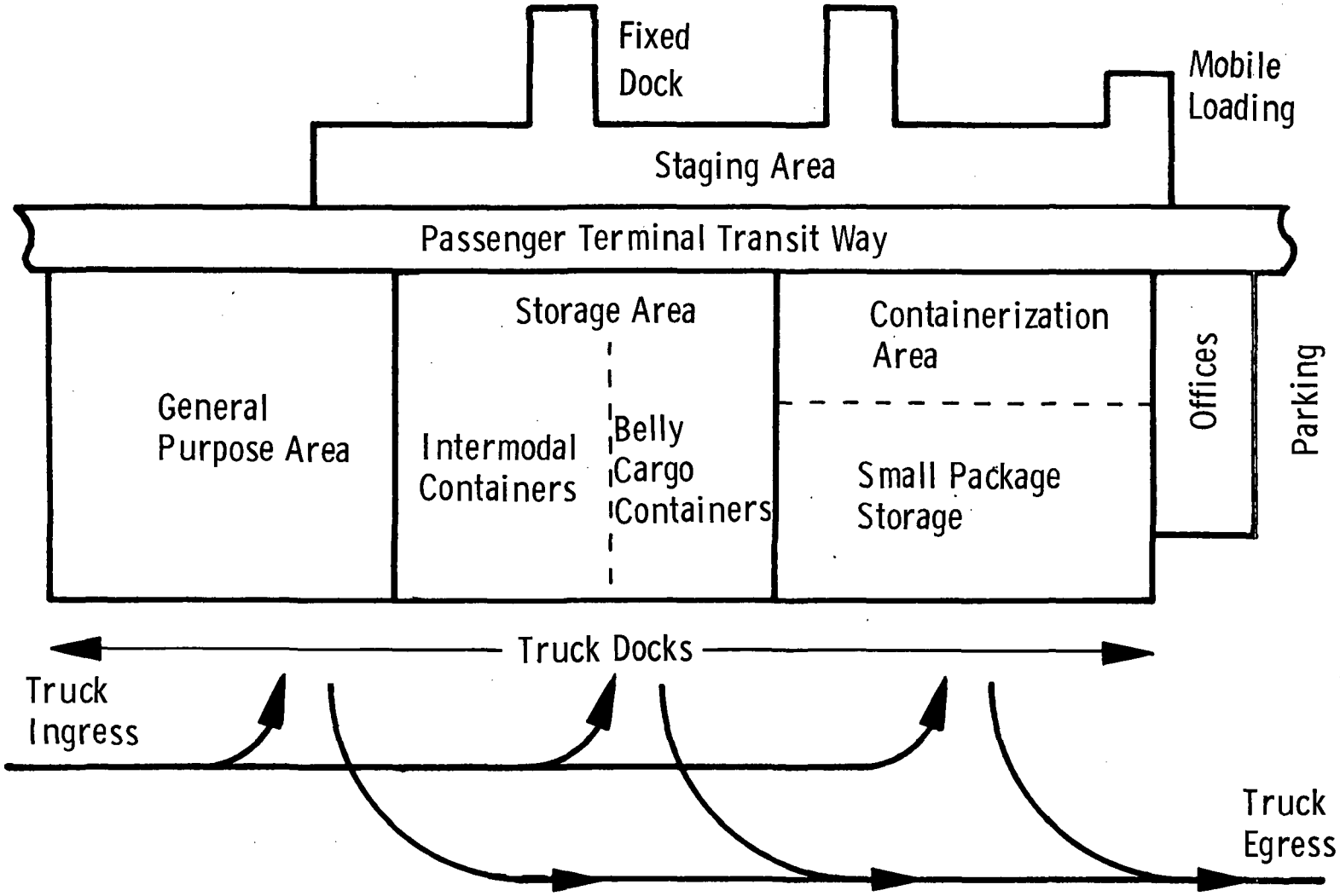

Figure 2.3 TERMINAL LAYOUT

for containers and a feeding mechanism for trays. The container and tray then move through the system in the same way as aircraft containers.

2.3.4. Loading Facilities and Equipment

The loading facilities include fixed and mobile aircraft handling units. In the fixed handling unit, the loading facilities are fully integrated with the terminal building and the aircraft taxies directly to the loading dock where a telescoping bridge raises and tilts to mate with the aircraft doors and the loading platform. From there on, the terminal handling equipment must be able to operate at the speed with which the aircarft unloads its pallets and containers, that is, at a speed of roughly 0.3m/sec, so as to take full advantage of modern methods of dealing with freight on the ground. These include standard size loading units, mechanical handling and locking, good coordination of flow inside the aircraft and on the ground with the aim of minimizing the combined loading and unloading times to something of the order of one or two hours total. A design feature of the fixed docking facility is a staging area that can move cargo to the aircraft either directly from a truck or from the cargo unitizing area. Cargos consolidated off-port need not pass through the freight classification facility. The truck offloading crane must place any ribbed bottom container on a tray. Automatic attachment between tray and container takes place before convey or transport through the terminal. The reverse process takes place when containers are removed from temporary automated high rise or horizontal storage and put on a truck.

Mobile handling equipment takes the cargo load to the aircraft at some arbitrary point on the apron, and can be used in periods of extremely high freight traffic or to handle loads from craft imcompatible with the fixed docks.

2.3.5. Summary

As shown in Figure 2.3, the air cargo terminal consists of the following systems and facilities.

2.3.5.1. Aircraft Loading Area

Here a loading dock and moveable bridge are connected to a double tier staging area providing temporary separate incoming and outgoing cargo storage. The fixed dockbridge system is capable of loading and unloading aircraft through the nose or side doors while the mobile handling aspect would be served by K-loader equipment.

2.3.5.2. Passenger Terminal Transit Way

This links the passenger terminal(s) to the freight terminal with access to main storage area to containerization area as well as the staging area. This could be part of a central distribution system forming the heart of the cargo terminal as it transported cargo in all its configurations to storage areas, containerization areas, loading and unloading zones.

2.3.5.3. Containerization Area

This covered area is used for cargo buildup and break down including storage for mixed general cargo arriving from the truck docks or awaiting pick up by small package delivery trucks. This area will diminish in importance with respect to the overall terminal as the airport rises in the terminal hierarchy toward hub status.

2.3.5.4. Storage Area

Intermodal containers as well as large packages offloaded from trucks are stored here. High rise storage racks capable of handling all containers could be used to minimize the floor area. A large part will be occupied by the belly cargo containers of the passenger aircraft.

2.3.5.5. Special Purpose Area

This area can be used for special purposes such as oversize cargo, livestock, and cold storage.

2.3.5.6. Administrative Area

The offices for the airlines, customs, and other services are housed here with separate parking facilities so as not to interfer with the delivery truck flow.

2.4 CUSTOMER COMMUNICATIONS

Introduction

No matter how effective a terminal operation is, it does not directly increase traffic moving on the air cargo system. It can lower the costs of transport, but customers must receive this information from somewhere if they are to respond by increasing their use of air cargo. The institutions, laws, and techniques by which information about freight movements is obtained, stored, and reported are, thus, integral parts of the total ground support system. This section will review these elements, particularly the marketing of air freight, the role of the forwarder in attracting and handling cargos, and the advantages of one-carrier waybills to ground support.

2.4.1. Customer Communication Service

Customer Communication Service (CCS) is the term we will use to describe the flow of information between the air cargo carrier and the customer (consignor). Its major goal is to maintain and increase the volume of cargo shipped by the carrier. Subsidiary goals which support this are:

1) Expediting customer shipments to satisfy the customer and to meet service standards

2) Maintaining satisfactory relationships between the customer and the air cargo carrier

3) Keeping air cargo carrier management information on matters affecting customer relationships.

The following activities are part of CCS:

1) Providing the customer accurate, timely information on tariffs, schedules, classifications, and packaging

2) Answering queries from the customer and consignee on location, status and expected time of arrival (ETA) of specific shipments

3) Persuading shippers to increase their use of air cargo

4) Receiving and arranging action on customer requests, complaints, and directions

5) Advising management on matters arising from CCS activities

6) Handling advertising public relations and media relationships.

Any procedures or equipment used to support these activites contribute to CCS.

2.4.2. Marketing Air Cargo

The type of marketing which increases volume generally revolves around activities 1, 3, and 6. There are several steps in this marketing process.

The first step is identification of air eligible products which are produced and shipped in large quantities in the area. The next step is to determine which shippers have the biggest volume of the air eligible products previously identified. The third is to contact those shippers identified as good prospects to convince them that air cargo will be more profitable than their present mode. The fourth step is to get the shipper to sign an agreement for air cargo service. The last step is the follow up to solve any problems which may have arisen and to verify that the shipper received the service he was sold. Airlines have not been successful in effectively executing all these steps.

While air eligible products have been identified by a number of NASA contractors and, presumably, within the market research sections of airlines, the air freight industry has had uneven success in establishing and communicating attractive tariffs.

Salespersons have even closed agreements with major shipping firms using outdated tariffs which were lower than contemporary ones. For example, the CAB denied WITS Air Freight, a Seattle-based air forwarder, an exemption for mistakenly charging a Miami shipper rates based upon a canceled tariff. The Board cited an exemption in the matter would encourage other carriers to request for exemption in similar action (ref. 27). Errors of this sort have hurt the public posture of the air freight business.

Activities 2 and 4, answering queries and handling consumer requests, can be facilitated by computer technology. The data systems of Air Canada (ACCESS) (ref. 28), or Emery's Air Freight are capable of tracing the status of freight on any mode of transportation within the system within 10 seconds. In tracing cargo shipped through Emery Air Freight, both the location and status of the cargo can be obtained with the airbill number or the name of the shipper and consignee. Both the Emery and ACCESS systems are capable of printing notices to the destination port, where governments honor them to speed the cargo through customs. Very little time, if any, is lost on documentation and the tracing and monitoring are reliable.

The fifth activity, informing management on CCS matters, is, of course, an in-house activity.

2.4.3. Marketing and Personnel

Almost every employee of an air cargo carrier communicates with customers as part of his or her duties; however, this section concerns the employees who spend all or most of their worktime dealing directly with the customer. Normally, there will be at least two categories of customer service representatives (CSR) -- inside and outside representatives. The functions of the inside CSR are:

1) To answer customer requests for information on tariffs, schedules, service, packaging, and similar matters

2) To answer their requests for information on specific shipments and relay their requests for action on a specific shipment to the proper individual

3) To encourage increased use of the carrier's air cargo service

4) To inform his supervisor as directed of any pertinent information obtained

5) To have a CSR available to the customer during working hours.

The functions of the outside CSR are:

1) To call on present and potential customers to persuade them to increase their use of the air cargo carrier's services. This requires sales ability and a thorough knowledge of air cargo advantages, services, tariffs, and packaging.

2) To respond in person to customer complaints and requests when a personal call is justified.

3) To represent the air cargo carrier at meetings, service clubs, and public groups.

4) If the carrier has no one specifically assigned to dealing with advertising media, act as the carrier's advertising manager.

Either the inside or outside representative can be the first contact that a potential customer has with the air cargo industry. It is extremely important that they be effective in this capacity.

There are several critical areas in the large air freight forwarding business that require expertise on the part of the salesperson. One such area is knowledge of containers types, capacity, ownership, shipping modes (i.e., A1 freighters, LD-3 widebodies, and QD standard bodies), allowable tare weight and handling features for shippers. Knowledge of what cargo can be priority one (First Freight of United) is required of all forwarders. Priority shipment carries a guaranteed boarding on-line transfer and a refund if commitments are not fulfilled.

Unfortunately, especially within the air freight divisions of large airlines, the development and quality of the salespersons holds a low priority in company goals. This low priority stems from the "by-product philosophy" of air cargo transportation. The by-product philosophy regards passenger traffic as the main business of the air line. It assumes that the air carrier would not operate to carry cargo unless the carrier also transported passengers. In air carrier accounting, all or almost all indirect costs can be charged against passenger traffic; only the direct operating costs of cargo service are charged against air cargo. Little or no indirect or general overhead expense is allocated to air cargo.

In essence, the entire function of the air freight department is to fill empty holds on passenger planes. While any additional revenues which can be gleaned this way are welcome, the suggestion of investments to maximize them is met indifferently.

There are at least four areas in which marketing for air cargo can be persuasive. These include:

2.4.3.1. Market Dominance

Market dominance may be defined as a market position which brings the holder the leadership position in pricing, product characteristics, marketing channels, customer financing, and other areas. For example, an independent phone company must make its equipment and accounting compatible with that of the Bell System, the market leader. Bell dominance extends to the color of the yellow pages and of the blue public telephone signs. The market dominant firm is usually the one with the largest share of the market for the product within the marketing area. Market dominance also has a time factor. The first firm in a market has the lead in the race for dominance and in the struggle to keep ahead. Air cargo can be instrumental in attaining early market penetration and in holding the lead.

2.4.3.2. Customer Service

Another strong motivation for using air cargo is improved service (shorter delivery time) to the customer. It has the advantage of easy measurement of the elapsed time from the consignor's shipping dock to the consignee's receiving area.

2.4.3.3. Budget

Many transportation decisions are made on the basis of a transportation expense budget set by management. The traffic or shipping manager must keep his transportation expenditures within his budget regardless of service, delivery time, profitability, or other factor.

The procedure separates the transportation mode decision from the decision-maker concerned with profit, overall cost, sales, or customer service. It also tends to encourage cheaper modes such as trucks over air cargo.

If transportation manager is limited in his modal choice by a strict budget, the customer service representative should try to reach the decision-maker who can authorize use of air cargo.

2.4.3.4. Deadlines

Much use of air cargo is to meet deadlines. It doesn't matter who sets the deadline or whether the deadline is necessary or rational. If the shipping manager is told to meet a deadline, he will ship by air if this will meet the deadline and if he can rely on the air cargo carriers ability to meet its schedule. This movitation will apply to non-profit and government organizations as well as to private business. A company may advertise its use of air cargo in the hope of increasing its clientele.

There are some modeling techniques which airfreight salespersons can employ in dealing with prospective customers, e.g., the Air Freight Decision Tool (AFDT)(ref. 29). The AFDT is used to help the shipper analyze his air transportation cost. The cost of shipping by air is compared to that for other modes through a modeling procedure. The variables used are value of the

product, density of product, start-up cost, and warehouse cost. A curve showing the break even point for transporting by air is among the products.

A problem in using these total inventory approaches is that the transportation manager of a company, the individual most likely to be contacted by an airfreight salesperson, may not have control over the inventory procedures of a company. His decision to use airfreight is based totally on his budget which covers only the transfer of goods and does not include costs of warehousing, etc. Thus, an appeal to a high level of management may be necessary to sell the use of air service, no matter how evident its advantages are.

The area of advertising is also one in which approaching the proper audience is critical. Most companies find that using an advertising agency is more satisfactory than doing the whole advertising job in-house. The agency's fee normally comes from a commission, according to which media are used. Thus the air cargo company would save little or nothing by not using the agency. In addition, a good advertising agency will have skills and contacts difficult for the air cargo company to acquire and maintain.

In what media should the air cargo carrier advertise? Some suggestions are:

1) Trade journals of industries producing air eligible cargo. Regional journals in the carrier's area are preferred if available. National journals are more expensive and have many subscribers in regions not served by the air cargo carrier.

2) Trade or professional journals directed at transportation managers.

The following are not usually successful because of the high cost per prospect:

1) TV, radio, and general circulation newspapers

2) Financial, commercial, and business general papers and journals

3) Trade journals of industries producing non-air eligible goods

4) General business periodicals

There is clear room for improvement in the manner in which airlines, especially airlines whose major business is passengers, organize and execute their customer communications services. Many of these improvements lie in giving more attention to freight operations. Others may derive from delegating certain of the CCS to other parties, i.e., the air freight forwarder.

2.4.4. Air Forwarders

If an advanced large air cargo (LAC) system is to become a viable enterprise, the freight forwarder/broker must assume the role of the central nervous system for the network. The justification given freight forwarders in 1955 by the CAB is just as appropriate today as it was then, ". . . . It

is in the public interest and need for, the service of air freight forwarders has been sufficiently established to justify the authorization of air freight forwarder."(ref. 30) The importance of the forwarder is supported by the CAB Files (Forms 244, schedule T-1) which listed freight forwarders as being responsible for tendering approximately one-half of the total freight to domestic trunk, all cargo and local service (ref. 31).

The objective of freight forwarders for the large air cargo industry of the 1990's will be to establish a one-carrier responsibility that will move cargo from dock-to-dock in a minimal amount of time, at a minimal cost to the consumer, with dependable and consistent service. The shipper would simply call the freight forwarder with a description of cargo, the time of shipment, and the destination of the shipment in question. The forwarder would be responsible for the cargo until it reached its destination. The achievement of this objective would mean that freight forwarders would offer shippers of large air cargo the same service that travel agencies offer air passengers and present freight forwarders offer for small packages service.

In designing a large air cargo system with dock to dock service for the 1990's, we must review the present state of the art. The new system may be a closed enterprise like Federal Express or it may be a forwarder with ground transportation who buys lift from commercial airlines.

There are several advantages that operations like Federal Express have:

1) Since 1972 the Civil Aeronautics Board ruled that operators flying aircraft with payloads of 1500 pounds or less could be classified as "air-taxi" operators. This classification allows them to fly to any city in the United States without having to file for a certificate of public convenience or need (ref. 32).

2) Federal Express owns its own ground carriers which allows it to do its own pick-up and delivery. This feature allows them to offer next day, door-to-door service to any city in which they have a branch office. Since only Federal Express personnel handle the parcel, they are able to account for it at any point.

3) Federal Express or any other small freight airline can plan their schedule for next day service, which prevents what Art Bass describes as, "Packages from being slaves to when and where the commercial carriers wanted to move people, which just may happen not to be where the parcel is going."(ref.33)

Federal Express has several other innovations that enable them to offer next day service. One is the STAR System (Systemwide Tracking and Recording). The STAR System has three major benefits to the company:

1) It allows Federal Express officials to know where a package is at any given time.

2) It minimizes billing and handling cost.

3) It provides an accurate and timely data base.

The STAR is aided by a computer with terminals at each of its branches. The package is scanned four times to insure accurate and reliable service. The four scanning points are listed below.

1) Origin City Station. The shipper calls the branch office in his city with a request for service. If he is a regular subscriber, he already has an addressograph data recorder. This allows the shipper to prepare the airbill (consignee address cards, return address, etc.) for FEC. The airbill contains four copies, one of which is used as a label for the package. The scanning is done when the carrier returns to his branch office in the shipper's city.

2) The second scan takes place in the Memphis Hub, where all packages are unloaded from the feeder aircraft and placed on a conveyor with a divert chute that utilizes zip codes. Once the divert chute has directed the package to the proper sender plane, it is scanned.

3) The package is scanned a third time when it reaches its destination city.

4) The fourth and last time the package is scanned is when the courier delivers the parcel to the consignee. The consignee's signature which indicated that he received the package is scanned when the courier returns to his branch office.

The air freight forwarders who buy lift from commercial airlines also have several advantages. The first advantage is that they usually employ indirect air carrier service, thus relying heavily on an aircraft owned and run by another organization. They know the exact flight schedule and route. The freight forwarders are free of the burden of making flight plans. Another advantage is that they avoid the high cost of operating an aircraft when their payload does not justify the flight.

There are several disadvantages for the air freight forwarders who employ commercial airlines to lift their cargo. First shipment carried by another carrier and across several modes makes tracing limited, if not impossible. In this event, the air freight forwarder is at the mercy of the passenger carrier with their scheduled and unscheduled delays. If a priority decision has to be made between passenger and cargo, the airline will usually go with 87% of its total income, the passengers.

2.4.5. Documentation

In order for the freight forwarding industry to achieve the objective, "of moving large air cargo from dock to dock in minimal time", improved technology in documentation procedures must parallel improvements in aircraft technology, intermodality, and ground support system. The air freight forwarding industry's biggest asset is time. It can't compete with other modes of transportation in terms of cost per shipment or volume per shipment. Time consumption is the airlines only superior quality. International trade by waterway between many nations is roughly 45 days, whereas by air it is less than one week (ref. 34).

In order for the air freight industry to reach its full potential, the delivery time of 6 days for international cargo must be reduced by one-half. The IATA reported the following graphic description for international cargo travel (ref. 34).

Function	Export Handling Agent	Export Custom	Export Carrier	Transfer Carrier	Import Carrier	Import Broker	Import Custom	Import Trucker
percent	15%	1%	15%	12%	15%	25%	2%	15%
days	1/2	1/4	1/2	1/2	1/2	1	1/2	1/2

The documentation procedure required for international air freight is to a large degree the cause of much of the delay.

Eric Rath reported that there are as many as 125 different types of documents in either regular or special use for international shipments (ref. 3). The 125 documents represents more than 100 separate forms. The forms include the bill of lading, through bill of lading, custom declaration, counselor documents, dock receipts, certificates of inspection and measurement, certificates and binders for insurance, banking documents, forwarders receipts, invoices, billing forms, and manifests. In addition to the forms in regular or special use, as many as 28 different governmental agencies may participate in a single export shipment.

New documentation procedures are needed that will cut down on the paper work and speed the cargo from the shippers' dock to the consignee's dock. Air Canada has made a step toward eliminating the greater portion of the paper work involved in the air cargo business (ref. 28). ACCESS (Air Canada Cargo Enquiring and Service System) is a data information system that prints out documentation paper as well as monitors the cargo at any point enroute. In 1976, the ACCESS System had 150 input terminals and 50 air waybill printers available for cargo business in 28 of Air Canada's offices, six in the United

States and four in Europe. The informational system is coded in the air waybill format. The computer is capable of performing the following operations with the coded data:

1) Work out the exact cargo costs

2) Note any instruction from the recipient (Example: Keep temperature above freezing)

3) Check the credit rating of the shipper

4) Print out waybill, if required

5) Pass on to the accounting department all data needed for billing

6) Prepare the weight and balance charts for the aircraft.

The system is sophisticated enough so that no papers have to accompany cargo inside of Canada and the number of papers accompanying international cargo has been drastically reduced. The waybill is printed and matched with the cargo at the destination in all of the airports within Canada.

Non-technical issues involved in documentation are Customs Clearance and apportionment of liability. The FMC, CAB, ICC, and IATA must solve these before international one-day dock to dock air freight will become a reality.

2.4.6. Single Waybill

To be effective, one carrier responsibility must include shipping under a single waybill. The single waybill covers inter-carrier agreements with all interline transportation agencies (air, rail, land, and sea) covering both tariffs and services for both domestic and international shipments. The advantages of shipping under a single document are: a) a reduction in billing and collections costs, b) the knowledge that the shipper or consignee knows exactly the total cost of the intermodal movement, c) the knowledge that one forwarder can monitor his shipment at any point and on any mode, and d) the knowledge that a single forwarder/carrier has liability for the shipment.

Shippers moving cargo using several modes of transportation where joint rates are not established often pay a higher cost than they would under a combination rate. In the case where an air freight forwarder tenders cargo from dock to dock where intermodal service is involved, only the forwarder initiates and processes the through bill of lading applicable to the trip (ref. 35). Since the down line carriers have lower terminal costs, their rate for service should be less; this would result in a lower cost to the shipper. Rates charged for door-to-door interline service by Emergy are more economical than if modes for each link charge to make an individual profit. Emery Air Freight owns its own ground support service and buys air service. With this arrangement, each segment of the haul doesn't have to show a profit as long as the overall operation does.

If each mode of cargo transportation service would publish joint rates, one of the problems of shipping under a single waybill would be eliminated.

If intermodal shipment under a single waybill is to become a reality, recommendation 17 of Problems of Through Responsibility and Liability must be accepted:

> "The ICC, the FMC, and the CAB in co-operation with the Department of Transportation should develop and publish one or more approved standard forms for inter-carrier agreements or apportionment of liability for intermodal shipment."(ref. 36)

The acceptance of this recommendation would solve a major problem preventing shipping intermodal cargo under a single waybill. In order for shipping under a single waybill to become a reality, domestic and foreign governmental agencies must co-operate with each other.

2.5 IMPACTS

Introduction

This section deals with the impacts the ground support system of an advanced air cargo system has on the environment around it. These impacts will be divided into three major areas: (1) Environmental, (2) Economic, and (3) Urbanization. The magnitude of any of these depends on several factors. The first factor is whether a new airport is being built or an existing airport is being expanded. A new airport would have far greater impacts than would an expansion program. The second factor which determines the magnitude of the impacts is the size of the airport. Again, a large hub-type airport has more significant impacts on the surrounding environ than a smaller spoke-type airport. In the discussion of the three areas of impacts, consideration will be given to both the new airport and the expanded airport. In addition, the significance of airport size will be discussed.

Even though this section deals with the impacts of the air cargo ground support system, there will be times when it will be difficult to separate this system from the passenger operation. Often it is the composite of these two airport operations that causes the impact.

2.5.1. Environmental Impacts

The construction of a new airport for air cargo or the expansion of an existing airport to handle increased air cargo will cause a number of environmental impacts. These impacts can be controlled to some extent by a good advanced planning program which gives high priority to the ecology of the surrounding environ. The environmental impacts may include the following:

(a) noise
(b) air pollution
(c) water pollution
(d) drainage pattern alternation
(e) water supply demand
(f) sewage disposal demand
(g) soil erosion
(h) wildlife displacement
(i) congestion of airport access roads
(j) fuel consumption

"The contribution of aircraft and airports to the deterioration of the natural environment are, at present, minor in comparison to the overall effects of urban and industrial development, the chief agents of environmental degradation."(ref. 37) However, as the air industry grows, so will its contribution to the degradation of the environment unless steps are taken to prevent it from happening.

What follows is a brief discussion of some of the environmental impacts mentioned above.

2.5.1.1. Noise

"Aircraft noise is presently the most urgent of all social-impact factors in civil aviation . . . . "(ref. 37) This opinion is one that is shared by many people, especially those living close to airports. The increase of air cargo traffic will certainly compound this problem in two ways. First, there will be an increased number of large, noisy airplanes and second, there will be the noise of the surface transportation carrying the cargo to and from the airport.

Noise is measured in CNR (Composite Noise Rating) or NEF (Noise Exposure Forecast). Noise levels below 30 NEF (100 CNR) are considered to be low enough so as not to produce complaints from those subjected to the noise. Noise between 30 and 40 NEF (100 and 115 CNR) will produce complaints and noise above 40 NEF (115 CNR) will probably initiate group action, such as a legal suit (ref. 37).

At present, there are a number of efforts being undertaken by the government and the aircraft industry to reduce noise around airports. These efforts are centered on three areas:

1) the source (aircraft)

2) the receiver (homeowner)

3) urban planning

There are several ways to reduce the noise from the source. First, the airplane engines can be designed to be less noisy. The L1011, a wide-body jet, is achieving noise levels below FAR Part 36 for takeoff, sideline, and approach (ref. 38). In addition to improved engine technology, airports can modify takeoff and landing procedures and times to further reduce noise impacts.

Once a homeowner has located near an airport, there is little that can be done by him, short of moving, to reduce noise levels. There have been attempts to sound proof the homes with limited success.

The final method of controlling noise is through the proper planning of urban development. This is such an important step that in order to receive federal money for new airports, the builder must show compliance with the Airport and Airway Development Act of 1970, as amended. This act requires

> "appropriate action, including the adoption of zoning laws, have been or will be taken, to the extent reasonable, to restrict the use of land adjacent to or in the immediate vicinity of the airport to activities and purposes compatible with normal airport operations, including landing and takeoff of aircraft."

There are some land uses that are not sensitive to noise, such as farm land, manufacturing centers, warehouses, and other transportation modes. These could be located close to airports. On the other hand, homes, schools, churches, and hospitals are very sensitive to noise and should be located at some distance from the airport (ref. 39).

Proper urban planning is the answer to the noise impact for a new freight airport. However, for existing airports, it is too late to plan. The answer for the existing airport is the purchase of land surrounding the airport and have it rezoned for noise insensitive uses. This is an extremely expensive solution, with land surrounding some airports being worth $300 000 or more per acre (ref. 40). On the other hand, law suits, lawyers, and other associated legal costs are also expensive.

Noise pollution is a problem shared by both passenger and freight operations. However, in promoting increased air freight operations, we must realize that the noise pollution problem is the single most important item constraining the growth of airports and airport operations.

2.5.1.2. Air, Water, and Land Impacts

In comparison with other sectors of the economy, airports and aircraft do not contribute much to the pollution of the air. However, the aircraft do produce combustion type emissions. There have been advances in engine design such as the turbine engine instead of the piston engine and other advances in combustor design (ref. 38). In addition, there is now the smokeless engine which eliminates visibility problems caused by the smoke generating engines. A large air freight operation also produces air pollution from the surface vehicles used to transport freight to and from the freight terminal. The impact of this pollution problem can be reduced by routing the airport access

roads through less densely populated areas. However, the control of air pollution is mainly a problem for new technologies.

"Although aircraft themselves do not contribute significantly to water pollution, terminal activities can exert significant effects on both surface and ground water through demands imposed on local water supplies, waste water discharge, or changes in drainage patterns."(ref. 37) In addition, the construction of terminals and runways destroys vegetation which can lead to soil erosion, further harming water supplies. It is estimated that, in order for air freight operations to derive the same revenue as passenger service now derives, it will require ten times as much terminal space (ref. 40). Thus air freight systems could use a significant amount of water as well as diminish the natural replenishment of water supplies unless careful resource planning takes place prior to construction.

2.5.1.3. Fuel Consumption

Currently the air transportation industry consumes approximately eight percent of the domestic fuel requirements (ref. 38). With the introduction of the widebody aircraft and improved engine efficiency, the trend of the fuel cost per tonne per kilometer is downward. However, much of this savings comes from the enormous payload capacity of the widebody airplane.

As petroleum based fuels become more expensive and scarce, technical advances will be required to support the aircraft and surface vehicles of the air freight industry. These advances may include the development of more efficient engines and/or the use of new fuels, such as hydrogen.

2.5.1.4. Airport Access Road Congestion

In general, airports are built convenient to major highways which provide good access, or the highways are promised. Approximately 90% of the ground access to airports, domestically, is by highway (ref. 37). Since air freight will require a significant amount of truck traffic to and from the airport, an additional strain will be placed on already overloaded road networks. For some of the large hub airports, ground access has become a major growth limiting factor (ref. 37, 40, 41). For these airports, land acquisition is also a problem which limits their ability to build additional highways.

There are three possible solutions to the access problem:

1) Use other modes to get freight and passengers to and from airports

2) Construct off-airport cargo facilities

3) Construct all cargo airports

The use of mass transit in the form of busses, subways, railroads, and helicopters between urban centers and the airport could reduce the congestion on the access network and reduce air pollution and fuel consumption as well.

The construction of off-airport freight terminals would reduce the truck traffic into and out of the airport. They also eliminate the problem of finding building sites on already land-scarce airports. These off-airport terminals would be used for consolidation of freight and could be shared with other freight transportation modes.

The final solution is an all cargo airport. This solution seems to be the least viable. In order to justify such an airport, there would have to be very large volumes of cargo such as might be found at a hub city. However, land is in general not available in these areas. Since belly cargo will still be carried on passenger flights, freight personnel, equipment, and buildings will be duplicated, which represents large sums of money and will necessarily increase the cost to ship by air. This would then reduce the air freight industry's ability to compete with the surface modes.

2.5.2. Economic Impacts

The economic impact of a new airport is much more dramatic than the expansion of an existing airport. In addition, the size and capabilities of the airport determine the economic impact, with the larger airports having greater impacts. Examples of economic impacts are:

(a) employment
(b) payroll
(c) commercial and industrial development
(d) increased land values

A hub-type airport can be a major employment center (ref. 41). For example, in 1970 Los Angeles International Airport employed 37 000 and was the second largest employer in the county (ref. 42). This represents direct employment such as airline, air traffic control, traffic, security, and maintenance personnel. In addition, airports create indirect jobs for people in freight forwarding, warehousing, and trucking as well as hotels, restaurants, construction, and car rental agencies. The total employment impact associated with an airport can be as many as 100 000 jobs (ref. 43).

If one were to assume an average annual wage of $7 400 for each airport-created job and assuming 50 000 such jobs, an annual payroll of $370 million would impact on the region. Further assuming an economic multiplier of 2.5 for the region, the airport would have a total regional economic impact of $925 million (ref. 44). This impact would normally be considered very positive. However, the creation of jobs and income in one region can drain the labor force and financial base of another region. Thus one region could grow economically at the expense of another.

There is also some controversy as to the proper employment and monetary multipliers to apply to airports. Transportation in general has a derived demand rather than an intrinsic worth; in that respect, it is a non-basic economic activity in a city or region. It does not generate income from outside the area, but re-circulates that derived from the basic industries which do bring in dollars. Thus, it is part of another industry's multiplier.

Alternatively, the transshipment traffic at an airport does not derive from the region, hence could pass through other airports. The income from and employment related to it can be considered basic to the city. Thus, hub airports have a large segment of their activity which is basic, while feeder airports are totally non-basic in their orientation. Thus, a uniform multiple is misleading and many local facilities have only the very limited multipliers related to the goods and services purchased locally by their employees.

The magnitudes of the above mentioned numbers are for new airports. The expansion of an existing airport to handle more freight will not have such large impacts. However, it will necessitate the building of new terminals and possibly runways on the airport, and warehouses and other facilities off the airport. The construction and operation of these facilities will impact on both employment and payroll (ref. 45).

2.5.3. Urbanization Impact

Historically transportation modes have created population centers. First it was the ship creating seaports and then the train creating railroad centers (ref. 46). In much the same way, airports have a nucleating effect on land development (ref. 37). As was stated in the preceding section, the airport is an employer. Since people prefer being close to their work, housing is built close to the airport starting the population movement. At the same time, air related business and industry, such as airline companies, freight forwarders, car-hire agencies, etc. locate near the airport. This creates more jobs and more housing. Next comes industry which uses air for shipment of its product. These companies normally manufacture a high value product. There are also businesses which move in to serve the air passengers such as motels, hotels, convention centers, and taxi services. Finally there is the business and industry that locate near the airport because of the good highway network (ref. 47).

In all, there are large numbers of jobs created which in turn leads to the creation of housing for the employees and their families. With this population center must come such services as fire and police departments, public utilities, hospitals, shopping centers, schools, etc.

This type of urban development can lead to good or bad impacts. Without proper land use planning, the entire urbanization process can be a total disaster. The result of poor planning is homes, schools, hospitals, and other noise sensitive land users being close to runways. However, through long range planning, the land around the airport can be zoned to achieve proper land use.

Another factor should be included in the planning for an airport. Where are the people, business, and industry coming from? Often times they come from surrounding towns and communities. If the exodus is large, the impact on thesetowns and communities can be devastating. Such impacts are often overlooked by planners.

The urbanization impact discussed above is for a new airport. The magnitude of the impact is dependent on the size of the airport and its geographic location. The expansion of an airport would not have a large scale urbanization impact. It would, however, create new jobs and draw additional business and industry to the area.

2.5.4. Summary

The creation of ground support facilities for an expanded air freight industry will generate a number of impacts on the surrounding environ. The size of the facilities and their geographic location will determine the magnitude of these impacts. The impacts can be divided into three categories: (1) Environmental, (2) Economic, and (3) Urbanization. The environmental impacts discussed are detrimental to the environ, but the magnitude of these impacts can be minimized through advanced planning. Both the economic and urbanization impacts can be good or bad. Again, proper planning is needed in order to make them have a positive impact on the environment.

2.6 ISSUES AND CONCLUSIONS

Several issues need resolution before the ground support element of an ACIS will fill its prescribed role. Some of these can be resolved for the total system by high level policy decisions, the attendant legislation, and the appropriate administrative procedures. The correct alternative on others is related to operating costs, thus will vary with local conditions. Issues can be broadly associated with two categories: 1) airport and terminal design, and 2) institutional/legal.

The design issues include:

1. What modes require access to ACIS terminals?
2. What networks and technology should be used to provide access?
3. Should gate arrival terminals be instituted?
4. Should off-port assembly and distribution centers for small package cargo be built?
5. Should dedicated freightports be built?
6. Are "union" cargo terminals appropriate to ACIS?
7. Should intermodal container storage be open or covered, or some mix of these modes?
8. Can the ISO/ANSI marine type intermodal container be made to be compatible with ACIS?
9. What are the appropriate dimensions of containers for air transit?
10. Is the use of intermodal containers essential to significantly increasing the volume?
11. Does extensive use of containers imply cube- or weight-out problems for interface with aircraft?
12. What bay dimensions and loading capabilities should aircraft have to ease the surface/air interface?
13. What degree of automation should be used in cargo sorting, handling, and storage?
14. What sort of interface should be provided between the terminal and aircraft, e.g., fixed conveyor or mobile devices?

The institutional/legal issues include:

1. How can documentation on cargo movements be simplified?
2. What can be done to improve the processing of documents?
3. Is one carrier responsibility and a one carrier waybill necessary to ACIS?
4. How might marketing procedures be improved to help capture more cargo, particularly air eligible shipments which have here-to-fore traveled by other modes?

5. How can air freight forwarders be better incorporated into the movement of small package cargo?
6. Can night flights for air cargo be maintained given environmental concerns in many communities?
7. What local and national land use planning requirements will be necessary to insure that airports with airfreight operations enhance the economic conditions locally while not detracting from intracity circulation, service delivery, and residential functions?

The evidence assembled in this section points towards certain rational courses of action with regard to these issues. First, it was shown that even through the 1990 period, trucking will be the major mode requiring access; COFC or possibly TRAILS rail access will also be useful at "air bridge" ports. The access technology need not be different from existing roadbuilding, but roads should be separated from passenger related traffic as soon as possible on entering the port authority property. Secondly, no alternative which abrogates economices of scale or divides belly freight in passenger planes from freighter cargo should be entertained. Thus, design alternatives like gate arrivals, off-site satellite terminals, and all freight airports, including military strips, are not considered feasible for ACIS. Union terminals, in that they enhance scale economies, are preferred. Third, it was evident that the ACIS should be designed around the 6.1m ISO/ANSI box in its various heights. This is appropriate to the lots of large package air eligible commodities likely to be transported in the projection period. Both the high tare weight of the containers and the higher density of this new type of traffic imply a reversal of the current loading problem in air cargo, i.e., in 1990 the planes will weight out before they cube out. All new craft can be expected to load the 6.1m boxes, hence should have nose or tail bays which can accomodate them. Fourth, it is evident that fixed docks are more efficient for moving containerized freight than mobile equipment. Such automation as supports these docks is beneficial. Alternatively, the degree to which automation is effective in small package handling is open to question. Many operations may not require it.

Finally, many of the service deficiencies of current operations could be eliminated by single-carrier responsibility, the single waybill that supports it, and computerization of the waybill and such additional documents as accompany given shipments. This would expedite transfer of cargos, allow direct contacts with the responsible transportation company by the customer, and facilitate accurate tracing of shipments through the system. Night service is also needed to attract an expanding business. Any aircraft or land use planning efforts which support night operation are beneficial.

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